

REMARKS

Claims 1-16 are pending.

Claims 1-3, 8-11 and 15 are rejected under 35 USC 103(a) as being unpatentable over Katsura, Japanese Publication No. 05-121785. This rejection is respectfully traversed.

Applicants previously asserted that the structure of claim 1 is different from that of Katsura, which has a light emitting diode lamp which has an optical lens that is symmetrical about a plane defined by the optical axis L as shown in Figures 1-9 of Katsura. As a result of this symmetry, the two convex lenses of Katsura are the same on both sides of the plane and therefore refract light equally, unlike the lenses of claim 1.

In response, the Examiner states, at pg. 2 of the Office Action, that Katsura teaches asymmetrical surfaces defined around a plane defined by the optical axis L, where one of the surfaces extends at an angle while the other runs parallel to the plane. Applicants note that the Examiner has failed to specifically point out where such a feature is disclosed in Katsura. Applicants assume that the Examiner is referring to the portions of element 16 (as shown in Fig. 1) which are directly to the left and right side of the LED 13, where it appears that the surface directly to the right side of the LED runs parallel to the L-axis and the other side runs at an angle slightly off of parallel. In this case, Applicants first point out that the Examiner appears to be judging the shapes and angles of these portions merely based on their appearance in the drawings and does not actually rely on a specific disclosure in the specification.

Further, Applicants submit that these surfaces do not meet the limitations of claim 1. Claim 1 recites “the convex lens has two different curved surfaces, one on each side of a plane, wherein the plane is orthogonal to a light emitting surface of the light emitting diode chip.” First, the surfaces of Katsura to which Applicants assume the Examiner is referring are not surfaces of a lens. The only curved surfaces of the lens of Katsura are located at the top of Fig. 1, and these curved surfaces are divided into left and right sides (looking straight at the drawing) by the L-axis. In fact, Katsura explicitly teaches in paragraph 0011 that the tip portion of the sealing resin, or mold

resin 16 serves as an optical lens. (See English translation of the Katsura reference.) The curved surfaces which lie directly to the sides of the L-axis appear to be symmetrical about that L-axis, in other words, are *not* “different,” as recited in claim 1. Again, claim 1 recites two different curved surfaces of the convex lens. The curved surfaces of the optical lens which lie one on each side of the plane which is orthogonal to the light emitting surface of the light emitting diode chip in Katsura are not different. Thus, Katsura fails to teach or suggest that which the Examiner asserts.

Furthermore, the Examiner admits that Katsura fails to teach one of the curved surfaces refracting outgoing rays of light from the LED more than the other curved surface, but that is obvious due to the very nature of the two different curved surfaces. The Examiner asserts that Katsura corroborates this by teaching that the brightest direction of the LED occurs at the optical axis of the convex lens. However, as stated above, the curved surfaces of the lens of Katsura are symmetrical about the L-axis, and thus the curved surfaces will refract light equally.

Accordingly, claim 1 is allowable over Katsura. The remaining claims are allowable at least due to their respective dependencies. Applicants request that this rejection be withdrawn.

Claims 4-7 are rejected under 35 USC 103(a) as being unpatentable over Katsura, as applied to claim 1, and further in view of Yamada, Japanese Publication 11-154766. This rejection is respectfully traversed.

Claims 4-7 are allowable at least for the foregoing reasons and further in view of Yamada’s failure to overcome the deficiencies of Katsura. Applicants request that this rejection be withdrawn.

Claims 12-14 and 16 are rejected under 35 USC 103(a) as being unpatentable over Katsura, as applied to claim 1, and further in view of Yamada. This rejection is respectfully traversed.

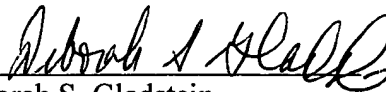
Claims 12-14 and 17 are allowable at least for the foregoing reasons and further in view of Yamada's failure to overcome the deficiencies of Katsura. Applicants request that this rejection be withdrawn.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue. If it is determined that a telephone conference would expedite the prosecution of this application, the Examiner is invited to telephone the undersigned at the number given below.

In the event the U.S. Patent and Trademark office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to Deposit Account No. 03-1952 referencing docket no. 204552029400.

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Respectfully submitted,

By 

Deborah S. Gladstein

Registration No.: 43,636

MORRISON & FOERSTER LLP

1650 Tysons Blvd, Suite 300

McLean, Virginia 22102

(703) 760-7753

Attachment: JP5-121785 with English translation and English abstract



PATENT ABSTRACTS OF JAPAN

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(71)Applicant : SHARP CORP

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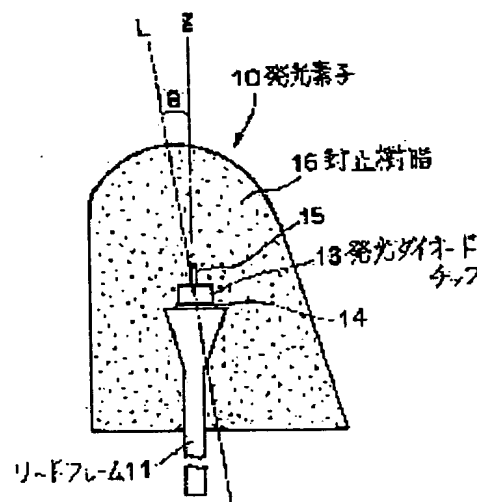
(72)Inventor : KATSURA YOSHINORI

(54) LIGHT EMITTING DIODE

(57)Abstract:

PURPOSE: To enable the brightest direction of a light emitting element to be tilted without inclining a substrate or forming a lead so as to control an optical axis.

CONSTITUTION: A light emitting diode chip 13 mounted on a lead frame 11 is sealed up with a transparent resin 16 which serves also as an optical lens. The optical axis L of the sealing resin lens 16 is tilted against a center axis z of the lead frame 11. As a result, the brightest direction of the light emitting element 10 is tilted against the center axis z of the lead frame 11.



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JP05-121785(A)

Title of the invention: LIGHT-EMITTING ELEMENT

Detailed explanation of the invention:

[0001]

5 The present invention relates to a light-emitting element used for a light-emitting display element of an information board and the like, for example.

[0002]

Prior art:

10 A general light-emitting element used for a light-emitting display element of an information board and the like is shown in Fig. 8 and Fig. 9. This light-emitting element includes two parallel lead frames 21, 22, a light-emitting diode chip 23 mounted on a tip of one lead
15 frame 21, said light-emitting diode chip 23 being wire bonded to a tip of the other lead frame 22, and a transmissive resin sealing the surrounding of the light-emitting diode chip 23. The sealing resin 24 is molded into a shell shape with a tip surface curved in a convex
20 shape, which also serves as an optical lens. An optical axis L of the optical lens coincides with a center line z passing the center of the light-emitting diode chip 23.

[0003]

25 If these light-emitting elements are arranged in a dot matrix on a substrate 20 to be integrated with a

driving system, as shown in Fig. 10, an information board, for example, is provided. Since the lens optical axis z of the light-emitting element coincides with a center line of the lead frame 21 passing the center of the light-emitting diode chip 23, the lens optical axis is perpendicular to the substrate 20 if the light-emitting element is fitted to the substrate as such.

[0004]

Problem to be solved by the invention:

Incidentally, the information board is usually installed in a high position to some extent because of its characteristics. Thus, it is required that the brightest direction (hereinafter referred to as element axis) be directed toward a person's eyes. Consequently, in a case of the information board in which the optical lens axis L is perpendicular to the substrate, the substrate is required to be tilted downward by a predetermined angle θ . In a case where the substrate 20 is not tilted as shown in Fig. 11, it is necessary to tilt the element axis by what is called a lead forming process in which the lead frames 21, 22 of the light-emitting element are bent.

[0005]

However, the information board has a high height as well as a heavy weight and thus when the entire information board is installed in a tilted manner, it is

necessary to take the strength design of fixing structural material into consideration sufficiently. Also when the substrate 20 is set in a tilted manner in the information board, the bad effect that the information board has an increased thickness and the like cannot be avoided. Further, it becomes difficult to implement automatic loading of the light-emitting element subjected to lead forming, which becomes a serious negative factor in terms of precision, number of processes even in the forming after the loading. Therefore, in tilting the element axis, neither tilting of the substrate 20 nor the lead forming is a preferred countermeasure.

[0006]

The present invention was made in consideration of these circumstances, and an object thereof is to provide a light-emitting element of a type in which an element axis is tilted, which does not require tilting of a substrate or lead forming.

[0007]

Means of solving the problem:

In a light-emitting element in which the surrounding of a light-emitting diode chip mounted on a tip of a lead frame is sealed with a transmissive resin, and a tip surface of the sealing resin is curved in a convex shape to serve as an optical lens, an optical axis of the

optical lens is tilted with respect to a center line passing the center of the light-emitting diode chip.

[0008]

[Action]

5 The element axis, namely the brightest direction coincides with the lens optical axis. Therefore, the lens optical axis is tilted with respect to the center line of the lead frame passing the center of the light-emitting diode chip, whereby the element axis is tilted with respect
10 to the center line of the lead frame.

[0009]

[Examples]

 An embodiment of the present invention will hereinafter be described with reference to the drawings.
15 Fig. 1 is a longitudinal cross section of a light-emitting element according to one embodiment of the present invention, Fig. 2 is a cross section of the light-emitting element, and Fig. 3 is a longitudinal cross section of an information board using the light-emitting elements.

20 [0010]

 A light-emitting element includes two parallel lead frames 11, 12. A light-emitting diode chip 13 is die-bonded to a tip of one lead frame 11 by a conductive adhesive 14. The light-emitting diode chip 13 is wire
25 bonded to a tip of the other lead frame 12 by a conductive

wire 15. The surrounding of the tips of the two parallel lead frames 11, 12 is sealed with a transmissive resin such as an epoxy resin, centering the light-emitting diode chip 13.

5 [0011]

The sealing resin 16 takes a shell shape, whose tip portion is curved forward to serve as an optical lens. The lead frames 11, 12 are inserted into the sealing resin in a state in which a center axis of the entire sealing
10 resin including an optical axis L of the optical lens is tilted at angle θ with respect to a center axis z of the lead frame 11 passing the light-emitting diode chip 13. Thereby, the brightest direction of the light-emitting
15 element 10, namely the element axis (coinciding with the lens optical axis) is tilted with respect to the center axis z of the lead frame 11 by angle θ .

[0012]

As a result, if the lead frames 11, 12 of the light-emitting element 10 are fitted to the substrate 20 as
20 such, the element axis is tilted with respect to a normal line of the substrate by angle θ . Therefore, it is not necessary to tilt the substrate 20 or implement lead forming in tilting the element axis with respect to a horizontal line. The tilt angle θ of the lens optical axis
25 L with respect to the center axis z of the lead frame 11 is

usually 5-30°.

[0013]

In the above embodiment, the sealing resin 16 has a construction in which its center axis is tilted with respect to the center axis z of the lead frame 11. Alternatively, as shown in Fig. 4, the sealing resin 16 may also take a construction in which only the optical axis L at a tip portion of the sealing resin, which almost corresponds to an optical lens portion, is tilted with respect to the center axis z of the lead frame.

[0014]

Portions other than the sealing resin 16 of the light-emitting element 10 are not specifically limited. For example, there may be made a two-color emitting light-emitting element in which two kinds of light-emitting diode chips 13a, 13b having different luminescent colors are mounted on a lead frame 11 at a center portion and they are respectively wire bonded to lead frames 12a, 12b on both sides thereof as shown in Figs. 5 and 6. Furthermore, as shown in Fig. 7, a lead frame 17 with its tip portion provided with a reflecting cup 17 can also be used. In this case, the lead frame 11 in which the reflecting cup 17 is bent is used so that a center axis of the reflecting cup 17 coincides with a lens optical axis, whereby bright light having a symmetry in its directional characteristic is

observed.

[0015]

Effect of the invention:

According to the light-emitting element of the
5 present invention, since the element axis is tilted with
respect to the lead frame, operation of the optical axis
such as tilting the substrate or bending the lead frame is
not required even when the element axis is tilted with
respect to the substrate of the information board.
10 Therefore, installation of the information board and the
like becomes easy, and automatic loading by a loading
apparatus is enabled.

Brief explanation of the drawings:

Fig. 1 is a longitudinal cross section of a
15 light-emitting element according to one embodiment of the
present invention;

Fig. 2 is a cross section of the light-emitting
element;

Fig. 3 is a longitudinal cross section of an
20 information board using the light-emitting elements;

Fig. 4 is a longitudinal cross section of a
light-emitting element of another embodiment of the present
invention;

Fig. 5 is a longitudinal cross section of a
25 light-emitting element of still another embodiment of the

present invention;

Fig. 6 is a cross section of the light-emitting element;

Fig. 7 is a longitudinal cross section of a light-emitting element of still another embodiment of the present invention;

Fig. 8 is a longitudinal cross section of a conventional light-emitting element;

Fig. 9 is a cross section of the light-emitting element;

Fig. 10 is a longitudinal cross section of an information board using the light-emitting elements; and

Fig. 11 is a longitudinal cross section of another information board.

15	10	light-emitting element
	11, 12	lead frame
	13	light-emitting diode chip
	16	sealing resin
	20	substrate
20	L	lens optical axis of sealing resin
	z	center axis of lead frame

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(71)出願人 000005049

シャープ株式会社

大阪府大阪市阿倍野区長池町22番22号

(72)発明者 桂 芳紀

大阪府大阪市阿倍野区長池町22番22号

シャープ株式会社内

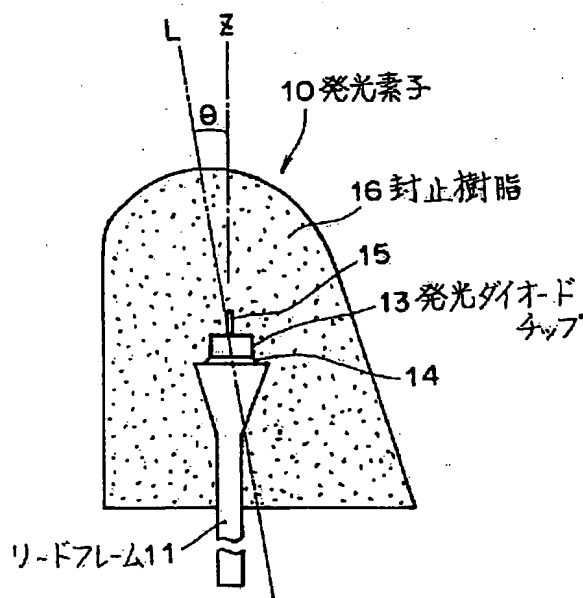
(74)代理人 弁理士 大西 孝治

(54)【発明の名称】 発光素子

(57)【要約】

【目的】 基板の傾斜やリードフォーミングといった光軸操作を行うことなく、発光素子の最も明るい方向を傾斜させる。

【構成】 リードフレーム11に搭載された発光ダイオードチップ13を、光学レンズを兼ねる透光性樹脂で封止する。封止樹脂16のレンズ光軸Lを、リードフレーム11の中心軸Zに対して傾斜させる。発光素子10の最も明るい方向が、リードフレーム11の中心軸Zに対して傾斜する。



【特許請求の範囲】

【請求項1】 リードフレームの先端に搭載された発光ダイオードチップの周囲を透光性樹脂で封止し、その封止樹脂の先端面を凸状に湾曲させて光学レンズとなした発光素子において、前記光学レンズの光軸を、発光ダイオードチップの中心を通るリードフレームの中心線に対して傾斜させたことを特徴とする発光素子。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、例えば情報案内板の発光表示要素等を使用される発光素子に関する。

【0002】

【従来の技術】情報案内板の発光表示要素等を使用される一般的な発光素子を図8および図9に示す。この発光素子は、2本の平行なリードフレーム21、22を有し、その一方の先端に搭載された発光ダイオードチップ23を他方のリードフレーム22の先端にワイヤボンディングし、発光ダイオードチップ23の周囲を透光性樹脂で封止した構成になっている。封止樹脂24は、先端面が凸状に湾曲した砲弾型とされ、光学レンズを兼ねている。光学レンズの光軸Lは、発光ダイオードチップ23の中心を通るリードフレーム21の中心線zに一致している。

【0003】そして、図10に示すように、この発光素子を基板20にドットマトリックス状に配列して駆動系と共に一体化したものが例えば情報案内板であり、発光素子のレンズ光軸zが、発光ダイオードチップ23の中心を通るリードフレーム21の中心線に一致していることから、発光素子を基板20にそのまま取り付ければ、そのレンズ光軸Lは基板20に垂直になる。

【0004】

【発明が解決しようとする課題】ところで、情報案内板は、その性格上、見る人の目の位置より幾分高いところに設置されるのが普通である。そのため、発光素子の最も明るい方向（以下、素子軸という）を見る人の目に向ける配慮が必要となる。そして、その配慮として、発光素子のレンズ光軸Lが基板に垂直な情報案内板の場合は、基板を所定の角度 θ だけ下方に傾ける必要がある。また、図11に示すように、基板20を傾けない場合は、発光素子のリードフレーム21、22を折り曲げる所謂リードフォーミングによって、素子軸を傾けることが必要になる。

【0005】しかしながら、情報案内板は嵩高で重く、案内板全体を傾けて設置する場合は、固定用構造材の強度設計に充分な配慮を払う必要があり、情報案内板内で基板20を傾けてセットする場合も、案内板が厚くなるなどの弊害を避け得ない。また、リードフォーミングを受けた発光素子は、基板20への自動装填が困難となり、装填後のフォーミングも、精度上、工数上、大きなマイナス要因となる。従って、素子軸を傾げるにあたっ

て、基板20の傾斜もリードフォーミングも、好ましい対策とはいえない。

【0006】本発明はかかる事情に鑑みて創案されたものであり、素子軸を傾げるにあたって基板の傾斜もリードフォーミングも必要としない素子軸傾斜型の発光素子を提供することを目的とする。

【0007】

【課題を解決するための手段】本発明にかかる発光素子は、リードフレームの先端に搭載された発光ダイオードチップの周囲を透光性樹脂で封止し、その封止樹脂の先端面を凸状に湾曲させて光学レンズとなした発光素子において、前記光学レンズの光軸を、発光ダイオードチップの中心を通るリードフレームの中心線に対して傾斜させたことを特徴としている。

【0008】

【作用】発光素子の素子軸、即ち、最も明るい方向は、レンズ光軸に一致するので、レンズ光軸が、発光ダイオードチップの中心を通るリードフレームの中心線に対して傾斜することにより、素子軸は、リードフレームの中心線に対して傾斜することになる。

【0009】

【実施例】以下、図面を参照して本発明の実施例を説明する。図1は本発明の一実施例にかかる発光素子の縦断面図、図2は同発光素子の横断面図、図3は同発光素子を使用した情報案内板の縦断面図である。

【0010】発光素子10は、平行する2本のリードフレーム11、12を有する。一方のリードフレーム11の先端には、発光ダイオードチップ13が、導電性接着材14によりダイボンディングされている。発光ダイオードチップ13と他方のリードフレーム12の先端とは、導線15によりワイヤボンディングされている。そして、平行する2本のリードフレーム11、12の先端部周囲が、エポキシ樹脂等の透光性樹脂により、発光ダイオードチップ13を中心として封止されている。

【0011】この封止樹脂16は、先端面が前方へ湾曲した砲弾型とされ、先端部が光学レンズになっている。そして、光学レンズの光軸Lを含む封止樹脂全体の中心軸が、発光ダイオードチップ13を通るリードフレーム11の中心軸zに対して、角度 θ だけ傾斜した状態で、封止樹脂16にリードフレーム11、12が挿入されている。これにより、発光素子10の最も明るい方向、即ち、素子軸（レンズ光軸に一致する）は、リードフレーム11の中心軸zに対して、角度 θ だけ傾斜する。

【0012】その結果、発光素子10のリードフレーム11、12を基板20にそのまま取り付ければ、素子軸は基板20の垂直線に対して角度 θ だけ傾斜する。従って、素子軸を水平線に対して傾斜させるにあたって、基板20の傾斜やリードフォーミングの必要がなくなる。なお、リードフレーム11の中心軸zに対するレンズ光軸Lの傾斜角度 θ は、通常 $5 \sim 30^\circ$ 程度とされる。

【0013】封止樹脂16は、上記実施例では、その全体の中心軸をリードフレーム11の中心軸zに対して傾斜させた構成になっているが、図4に示すように、封止樹脂先端部のほぼ光学レンズ部分についてのみ、その光軸Lをリードフレーム11の中心軸zに対して傾斜させた構成とすることもできる。

【0014】発光素子10の封止樹脂16を除いた部分については、特に限定せず、例えば、図5および図6に示すように、中央のリードフレーム11に発光色の異なる2種類の発光ダイオードチップ13a、13bを搭載し、それぞれを両側のリードフレーム12a、12bにワイヤボンディングした2色発光素子であってもよい。また、図7に示すように、先端に反射カップ17を設けたリードフレーム11の使用も可能であり、その場合は、反射カップ17の中心軸がレンズ光軸に一致するように、反射カップ17を曲げたリードフレーム11を使用することにより、配光特性に对称性のある明るい発光が得られる。

【0015】

【発明の効果】以上、本発明にかかる発光素子による場合には、リードフレームに対して素子軸が傾斜されるので、情報案内板の基板に対して素子軸を傾斜させるようなときにも、基板を傾斜させるとかリードフレームを折り曲げるといった光軸操作が不要になる。そのため、情報案内板の設置等が容易になり、また、装填機による自動装填が可能になる。

*【図面の簡単な説明】

【図1】本発明の一実施例にかかる発光素子の縦断面図である。

【図2】同発光素子の横断面図である。

【図3】同発光素子を使用した情報案内板の縦断面図である。

【図4】本発明の他の実施例にかかる発光素子の縦断面図である。

【図5】本発明の更に他の実施例にかかる発光素子の縦断面図である。

【図6】同発光素子の横断面図である。

【図7】本発明の更に他の実施例にかかる発光素子の縦断面図である。

【図8】従来の発光素子の縦断面図である。

【図9】同発光素子の横断面図である。

【図10】同発光素子を使用した情報案内板の縦断面図である。

【図11】他の情報案内板を示す縦断面図である。

【符号の説明】

10 発光素子

11、12 リードフレーム

13 発光ダイオードチップ

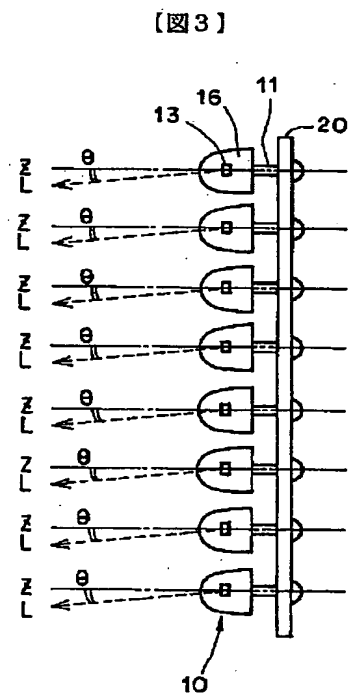
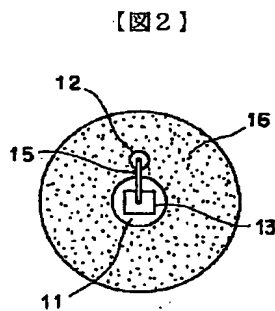
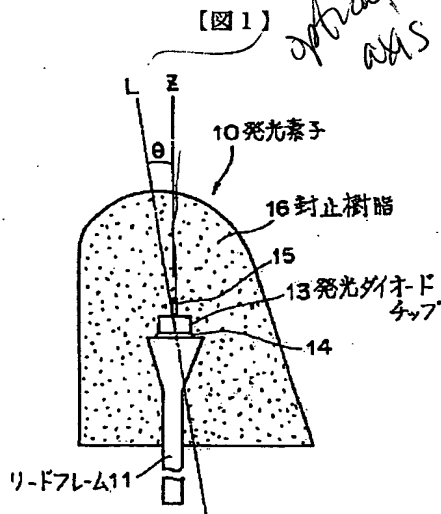
16 封止樹脂

20 基板

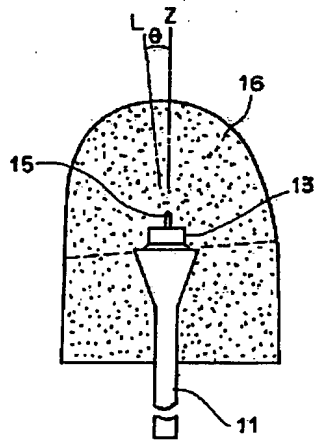
L 封止樹脂のレンズ光軸

z リードフレームの中心軸

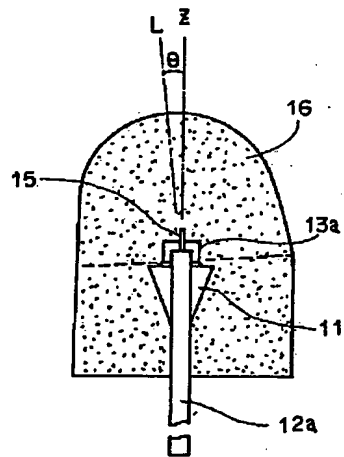
*



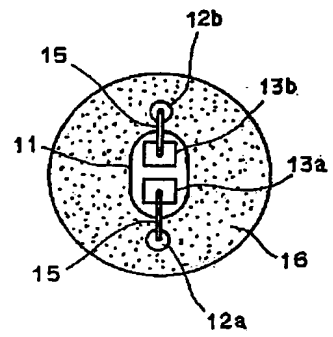
【図4】



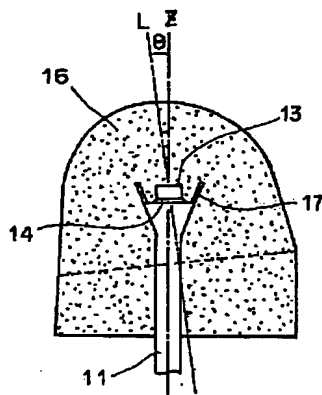
【図5】



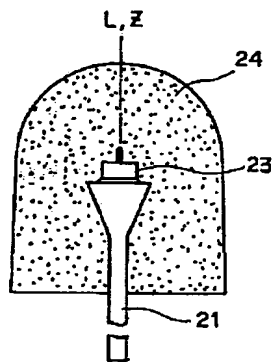
【図6】



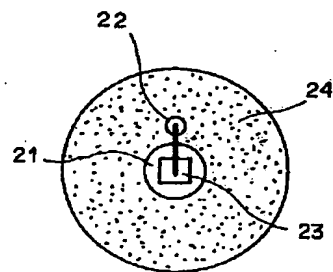
【図7】



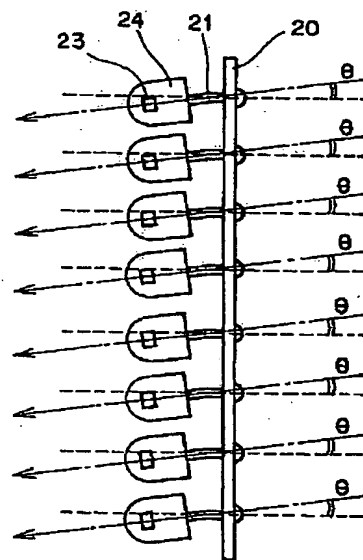
【図8】



【図9】



【図11】



【図10】

